Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 923-926

Received: 16-07-2018
Accepted: 17-08-2018

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Erysipeloid: Occupational disease

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Abstract
Erysipeloid is an occupational infection caused due to penetration of *Erysipelothrix rhusiopathiae* resulting in local skin infection usually cellulitis. The disease is mainly reported from the persons associated with occupation related to animals, mainly swine, thus, include animal breeders, veterinarians, slaughter house workers, furriers, butchers, fishermen, fishmongers, housewives, cooks and grocers. The infection is usually seen in two form: true erysipeloid and diffuse cutaneous form. Generally characterized by an inflammatory plaque, with well-defined and raised borders which is bright red-purplish in colour. Septicemia is a more serious manifestation of *E. rhusiopathiae* infection, almost always linked to endocarditis. Endocarditis occur in 75% of cases involving aortic valve commonly. Diagnosis of Erysipeloid is based on the patient's occupation, previous traumatic contact with infected animals or their meat, typical skin lesions (erythematous oedema with well-defined and raised borders, or vesicular–bullous–erosive lesions on an erythematous base, usually localized to the back of one hand and/ or fingers). Rarely found to be associated with encephalitis, meningitis, renal failure and peritonitis.

Keywords: Erysipeloid, occupational disease, *Erysipelothrix rhusiopathiae*

Introduction
Erysipeloid is caused due to traumatic penetration by *Erysipelothrix rhusiopathiae*. The disease is known as Rosenbach's disease as lesions of skin infection caused by *Erysipelothrix rhusiopathiae* were described by Rosenbach in 1884 by injecting the organism into his arms and also he named it as erysipeloid (Reboli and Farrar, 1989) [1]. The disease is known as pseudo-erysipelas to distinguish it from human streptococcal disease erysipelas (Wang *et al.*, 2010) [2].
The disease is well known but the infection with *E. rhusiopathiae* are less documented with only few reports [3-26]. Mostly cases are been documented in chronic stages with association with endocarditis especially in males because of their occupational exposure.

Etiology and Epidemiology
Erysipelothrix rhusiopathiae is a rod-shaped gram-positive bacteria, facultative aerobic, non-motile, non-sporulating (Wood, 1992) [27]. The organism grows at 4˚-41˚C (37 ˚C) with pH ranges from 7.4-7.8. The genus *Erysipelothrix* contains five species, *E. rhusiopathiae* and *E. tonsillarum*, *Erysipelothrix* sp. strain 1 (*E. rhusiopathiae* serotype 13), *Erysipelothrix* sp. strain 2 (*E. rhusiopathiae* serotype18) and *E. inopinata* (Veraldi *et al*., 2009) [28]. *E. rhusiopathiae* consist of 17 serotypes (1a, 1b, 2a, 2b, 4, 5, 6, 8,9, 11, 12, 15, 16, 17, 19, 21 and type N) out of which 1a, 1b and 2 types commonly affect swine (Bender *et al*., 2011 and Tang *et al*., 2016) [29,30]. The human erysipeloid is mostly caused due to involvement of serotypes 2, 7 and 16 (Veraldi *et al*., 2009) [28].
The organism is being isolated from a wide range of hosts including wild and domestic mammals, birds and reptiles and even from invertebrates (Wood *et al*., 1975) [31]. Pigs and birds are considered to be an important reservoir for the human infection (Lee *et al*., 2011) [32]. *E. rhusiopathiae* can be present in approximately 30–50% of apparently healthy pigs in their tonsils and lymphoid tissues of alimentary tract (Veraldi *et al*., 2009) [28]. These carriers can shed the organism in their faeces, urine, nasal and saliva, thus, an important source of infection. In case of pigs, contaminated fish meal serves as an important source of infection because the organism is known to be present for longer time on the mucoid exterior slime of fish (Wood, 1975) [31]. In case of human which are occupationally exposed to infected animals and their by-products (meat, bone, flesh scales and crustaceans shells) serves as important source of infection (Tolis *et al*., 2015) [33]. The disease is mainly found in animal breeders, veterinarians, slaughter house workers, furriers, butchers, fishermen, fishmongers, housewives,

cooks and grocers (Veraldi *et al*., 2009) [28]. The organism can survive in water and meat product for a longer period of time (Wood, 1975) [31]. The organism penetrates skin through tiny breaks. Human- to- human transmission has not been recorded (Tolis *et al*., 2015) [33]. Direct transmission to man from infected swine is uncommon.

The organism is ubiquitous in nature and is able to persists in nature for a long period of time. The bacterium remain viable for several months in animal tissues, decaying carcass, dried blood and fish meal. The organism persist in pig feces upto 5 months (Veraldi *et al*., 2009) [28]. *E. rhusiopathiae* killed by moist heat at 55 ˚C for 15 min, gamma irradiation and common disinfectant can destroy the organism and also it is resistant to many of the preservation methods, including salting, pickling, and smoking (Reboli and Farrar, 1989) [1]. The common names for human erysipeloid are whale finger, seal finger, speck finger, blubber finger, fishpoisoning, fish handler's disease, anglers and pork finger depending upon the mode of occupational exposure. Most of the infection are due to scratch and puncture wounds of the skin while handling infected animals.

Pathogenesis

There are several virulence factors that play important role in the establishment of the organism. Neuraminidase, an enzyme that cleaves sialic acid from the cell surface which helps the organism to attach and invade host cells (Shimoji, 2000) [34]. Hyaluronidase helps in spreading of the bacteria into the tissues (Shimoji, 2000) [34]. The bacterium also possess capsular polysaccharide that resist phagocytosis by the host cells (Shi *et al*., 2012) [35]. Two novel adhesins surface proteins RspA and RspB are found to play important role in biofilm formation (Shimoji *et al*., 2003) [36].

The bacillus after gaining entry through the skin wound will reach the circulation through the lymph. Septicaemia will develop and due to liberation of toxins that injure the blood vessels wall giving rise to erythematous lesions of skin and hemorrhages in various parts of the body. In some cases, septicaemia may subside and the organism may localize in the skin, causing thrombosis of small vessels giving diamond shape raised areas of erythema resulting in necrosis and gangrene in severe cases. In chronic cases, there is a connective tissue activation in predisposed sites of infection, including joints, heart valves, and skin. Sequestration of *E. rhusiopathiae* in the cytoplasm of chondrocytes of articular cartilage contributing to chronicarthritis.

Clinical Manifestation

The disease is seen two clinical form, the "true erysipeloid" and "diffuse generalized form" (Veraldi *et al*., 2009) [28]. Apart from these two forms septicemic form is also seen. True erysipeloid is local cutaneous lesions characterized by raised pruritic, purplish-red plaque with well-defined border. The lesions are seen mainly on the back of one hand and/or fingers and rarely involves palms, forearms, arms, face and legs (Veraldi *et al*., 2009) [28].'Whale finger' and 'sealfinger' are common terms used to describe sever swelling of the finger. Systemic and generalized cutaneous form is uncommon and commonly seen in immunocompromised persons with symptoms. Fever, lymphadenitis, arthralgia and myalgia is also been observed along with skin lesions. Septicemic form is usually associated with endocarditis (Rihana *et al*., 2018) [37].

Sometimes, the lesions may spread leading to generalized skin lesions with widespread erythematous–oedematous lesions. In chronic case, endocarditis is seen commonly involving aortic valves. Other complications such as encephalitis, meningitis, renal failure, peritonitis, and sepsis are also involved with *E. rhusiopathiae*.

Diagnosis

Diagnosis should be mainly based on the patient's occupation with history of traumatic contact or exposure to the infected animal or their by-products and typical skin lesions. Biopsy or aspirates from the edge of the skin lesions should be taken as a specimen. Biopsies should be of the entire thickness of the dermis because the organism is present in deepest part of the body. The specimen should be put into an infusion broth of 1% glucose immediately after collection and should be kept at room temperature or refrigerated until it reaches the laboratory.

The bacterium is not fastidious, therefore, require blood based media in the presence of 5-10% CO_2 isolation where it produces alpha hemolysis, but never beta hemolysis. Commercially available selective media such as *Erysipelothrix* selective broth (ESB), Modified blood azide (MBA), Packer's medium and Bohm's medium are also available (Wang *et al*., 2010) [2]. Two distinct morphological forms grow on solid agar media i.e., smooth (S) colonies are bluish, transparent and convex and rough (R) colonies are larger and have a flat rough surface with irregular edges. *Erysipelothrix* species are generally biochemically inactive and are negative for catalase, oxidase, methyl red, indole, esculin, nitrate reduction, Voges-Proskauer and liquefaction of gelatin. Gram's stain, cultural morphology, motility, hemolytic characteristics and biochemical properties, particularly hydrogen sulphide (H2S) production can be used for identification of bacterium. Hydrogen sulphide (H2S) is produced by 95% of strains of *Erysipelothrix* species which help to distinguish it from other gram positive rods. Sucrose fermentation is used to distinguish sucrose fermenter *E. tonsillarum* from *E. rhusiopathiae.*

Mice protection test is confirmatory test for *Erysipelothrix*. Alternatively, direct and indirect fluorescent antibody tests can also be used to confirm the identity of *E. rhusiopathiae*. Currently, genus- specific or species- specific PCR assays are developed. PCR identification usually done using 16S rRNA, 23S Rrna and 5S rRNA (Pal *et al*., 2010) [38]. PCR targeting virulence associated genes such as presence of capsule synthesis gene (cpsA-C), neuraminidase (nanH.1 and nanH.2), hyaluronidase (hylA-C), surface protective antigen (spa), adhesion, rhusiopathiae surface protein (rspA and rspB) can also be carried out (Ding *et al*., 2010) [39].

Treatment

Erysipeloid lesions can be affectively treated with penicillin for 7 days orally will resolve the case within 48 hours otherwise intravenous penicillin is recommended in serious cases. Recently the bacterium has shown resistance to penicillin, first line of treatment (Rihana *et al*., 2018).

The organism is sensitive to cephalosporins, tetracyclines, quinolones, clindamycin, erythromycin, imipenem and piperacillin but found to be resistant against vancomycin, chloramphenicol, daptomycin, gentamicin, netilmicin, polymyxin B, streptomycin, teicoplanin, tetracycline and trimethoprim /sulfamethoxazole (Veraldi *et al*., 2009 and Romney *et al*., 2001) [28, 40]. The vancomycin is a drug of choice for skin infections cannot be used in case of *E.*

rhusiopathiae because of the intrinsic resistance of bacterium (Rihana *et al*., 2018) [37].

Prevention and Control

To control the occurrence of disease in man, it is important to control disease in animals. Sound husbandry, herd management, good sanitation and immunization procedures can be employed to control and prevent disease. Immunizing the pigs is one of the best approach to control its occurrence in person who is occupationally exposed. Currently, attenuated live vaccines and bacterins which can be delivered intramuscularly or orally via drinking water, respectively are available (Eamens *et al*., 2006) [41]. These vaccines are based on serotype 1 or 2 which provide immunity from 6 to 12 months. Removal or regular disinfecting of contaminated sources such as feed, water, infected animals, etc. which will limit the spread of the organism. The organism can be readily killed by common disinfectant.

An awareness of the infection among individuals at-risk occupation is essential. Wearing of gloves or other protective hand wear, good hygiene, especially frequent hand-washing with disinfectant soap, and the prompt treatment of any small injuries can help to prevent disease. Proper meat hygiene should be incorporated in abattoirs and slaughter house for dissemination of infected materials. No vaccination is available for human use. Carcass should be condemned in cases of septicaemia whereas in case of local urticarial form, affected tissues should be carefully removed by the veterinarian.

Conclusion

This is the review of the erysipeloid infection caused by *Erysipelothrix rhusiopathae* which is generally under reported or under diagnosed. Erysipeloid lesions are considered to be rare or it may be due to misdiagnosis with other skin infections. As no immunization for human, so those occupationally exposed will be at risk as long as meat and fish are being consumed. There is need to educate people working in contact with animals especially pigs and marine animals (fishes, prawns, etc.). Proper care during handling animals and their product, good personnel hygiene, protective clothing and surveillance is required to control disease in occupationally exposed. Any cases of puncture wounds during work operations should be taken care for *Erysipelothrix* infection.

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